'ERSION*

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 3 : H01S 3/086

A1

(11) International Publication Number: WO 80/01123

(43) International Publication Date: 29 May 1980 (29.05.80)

(21) International Application Number: PCT/US79/00881

(22) International Filing Date: 12 October 1979 (12.10.79)

(31) Priority Application Number: 959,391

(32) Priority Date: 9 November 1978 (09.11.78)

(33) Priority Country: US

(71) Applicant: HUGHES AIRCRAFT COMPANY [US/US]; Centinela Avenue and Teale Street, Culver City, CA 90230 (US).

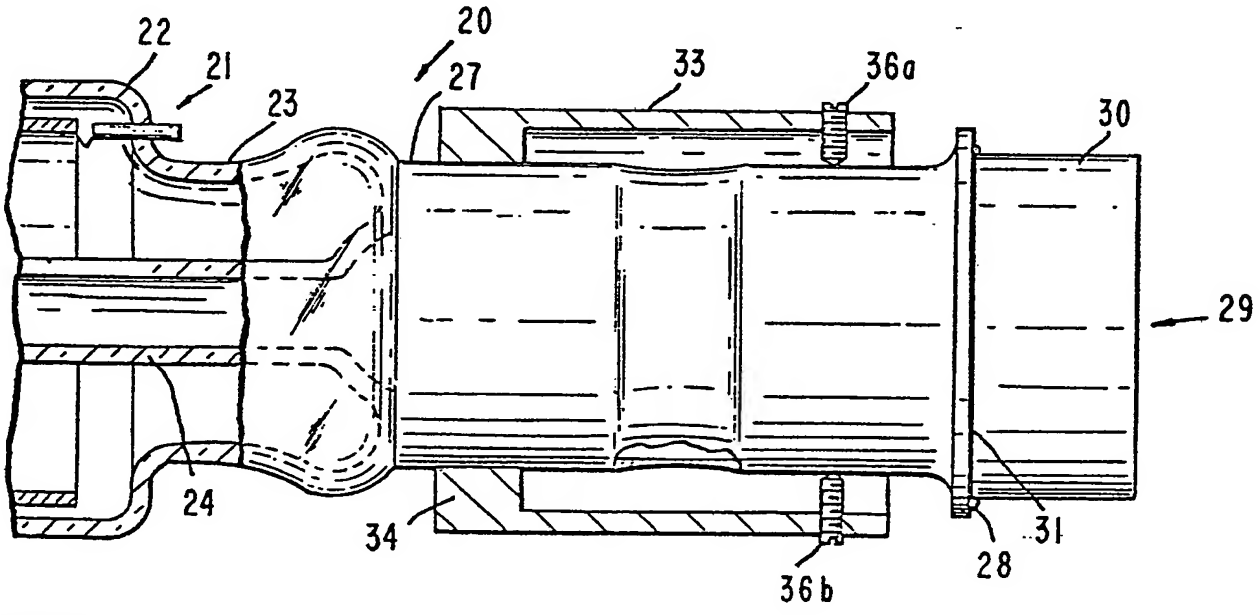
(72) Inventor: KOLB, William, P., Jr.; 3690 Highland Drive, Carlsbad, CA 92008 (US).

(74) Agents: MACALLISTER, W. H. et al.; Post Office Box 90515, Los Angeles, CA 90009 (US).

(81) Designated States: DE, JP.

Published
With international search report

(54) Title: ADJUSTABLE MIRROR MOUNT FOR A LASER



(57) Abstract

A mirror mount assembly which is attached to a laser tube and permits the adjustment of the mirror relative to the axis of the tube. It has an inner cylindrical member (27) one end of which is sealed to a laser tube (21) and a mirror (29) mounted to the other end. The midsection circumference of this cylinder may be made thinner so that it can be easily deflected about its axis. There is also an outer cylindrical member (33) which is coaxial to and surrounds the inner cylindrical member and a plurality of adjustment screws (36a-36d) which are radially disposed at the end of the outer member for deflecting the inner cylindrical member and the mirror.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria
AU	Australia
BR	Brazil
CF	Central African Republic
CG	Congo
CH	Switzerland
CM	Cameroon
DE	Germany, Federal Republic of
DK	Denmark
FR	France
GA	Gabon
GB	United Kingdom
HU	Hungary
JP	Japan
KP	Democratic People's Republic of Korea
LI	Liechtenstein
LU	Luxembourg
MC	Monaco
MG	Madagascar
MW	Malawi
NL	Netherlands
NO	Norway
RO	Romania
SE	Sweden
SN	Senegal
SU	Soviet Union
TD	Chad
TG	Togo
US	United States of America

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT

AT	Austria	LU	Luxembourg
BR	Brazil	MC	Monaco
CF	Central African Republic	MG	Madagascar
CG	Congo	MW	Malawi
CH	Switzerland	NL	Netherlands
CM	Cameroon	RO	Romania
DE	Germany, Federal Republic of	SE	Sweden
DK	Denmark	SN	Senegal
FR	France	SU	Soviet Union
GA	Gabon	TD	Chad
GB	United Kingdom	TG	Togo
JP	Japan	US	United States of America

ADJUSTABLE MIRROR MOUNT FOR A LASER

TECHNICAL FIELD

The invention relates generally to gas lasers and in particular relates to an improved adjustable mirror assembly for a laser.

BACKGROUND ART

Lasers have highly reflective mirrors located at either end of a lasing medium for stimulating light emissions and reflecting those emissions between them. Various schemes have been devised to permit alignment of these reflective mirrors relative to the axis of the laser plasma tube. Initially, the mirrors were mounted outside the evacuated plasma tube, which was usually terminated with Brewster windows, and placed in separate housings which were mechanically referenced or aligned to the laser plasma tube.

Gas lasers are generally constructed by two techniques; the first technique utilizes a plasma tube bottle in which windows (usually Brewster angle windows) are attached to the vacuum envelope and in which the regenerative cavity mirrors are supported externally to the bottle. It is a relatively uncomplicated matter to align and adjust the externally mounted mirrors. If the mirrors are properly aligned, the laser will function, and function well. If not, however, either the laser will not function at all or function only minimally.

It is desirable to have a mirror assembly which is an integral part of the laser plasma tube, not just an

BUREAU OMPI WIPO

appendage as some prior art lasers, in order to provide a more compact package. Also, an integrated plasma tube and mirror combination provides a more stable arrangement.

In the second technique, generally referred to as the "internal mirror" method, laser mirrors are attached directly to cylindrical metal housings at either end of the plasma tube which, in turn, are sealed to the vacuum bottle. The mirrors at either end complete the vacuum envelope. Each mirror is usually deposited on a cylindrical glass substrate which is sealed in place with a glass frit or glass solder by placing the entire laser tube assembly in a 450°C oven.

More and more the laser industry is turning to the internal mirror technique even though such a technique poses certain problems. In order to hard seal the mirrors into place, they must be either pre-aligned to the bore of the resonant or laser cavity before sealing or must be aligned after sealing, i.e., while the laser is in operation. Pre and post sealing alignment has been a difficult proposition.

One of the leading devices for adjusting a laser internal mirror is the well-known mirror mount fitting according to U.S. Patent No. 3,826,998. The mirror mount fitting includes a metal member having a weakened wall corrugation formed circumferentially therearound with a window closing the outer end of the fitting. The inner end of the fitting is made integral with the end of the laser tube and the reflecting mirror is formed on the closing window itself. The corrugation or single bellows-type formation on the fitting may extend inwardly or outwardly of the tube axis and is substantially weaker and of substantially lesser thickness than the remainder of the fitting wall. The fitting may be deformed at the corrugation such that the yield point of the material is exceeded to a sufficient extent to adjust the mirror to a desired position relative to the tube axis. There are

BUREAU CYPI WIPO INTERNATIONAL

several limitations of such a device. A drawback of this prior art device is that the corrugation must be deformed beyond the elastic limit of the material so that the mirror will be set in place and not moved. Another undesirable feature is that the plastically deformed cylinder must be shielded from being bumped or jarred because the deformed area is weak and the cylinder may easily be deflected if bumped.

Another prior art device is a mirror holder assembly composed of two cylindrical members which are axially assembled together to form a gas tight seal at the joint. One end of the mirror holder assembly is attached to the plasma discharge tube while a mirror is mounted to the other end. Each of the cylindrical members has a flange which is perpendicular to the axis of the cylinders and the two flanges are separated by 2.54 mm (.10 inch) from each other. Screws extend through one of the flanges and press against the other flange. To adjust the mirror, the leverage of the screws is used to tilt the endmost cylinder thereby adjusting the alignment of the mirror. Such a device, although providing highly accurate and precise mirror adjustments, is costly to machine.

DISCLOSURE OF INVENTION

In accordance with the present invention, an adjustable mirror mount for a laser is provided which has an inner cylindrical member with one end attached to a laser tube and the other having a mirror mounted thereon. An outer member surrounds the inner cylindrical member and is annularly separated therefrom. A plurality of radially disposed lever means extend through the outer member and impinge upon the inner cylindrical member for deflecting said inner member thereby adjusting the mirror.

BUREAU

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a partial cross-sectional view of an adjustable mirror mount, according to the present invention. The laser 20 includes an elongated plasma tube 21 having a relatively larger diameter main body envelope portion 22 and a relatively smaller diameter anode envelope portion 23. An elongated capillary hollow discharge tube 24 is supported by the anode envelope 23. The plasma tube 21 contains an active laser gas or mixture such as He-Ne, for example. The gas is allowed to circulate within the plasma tube 21, the capillary tube 24, and through an aperture in the capillary tube 24 at the other end (not shown) of the tube 24.

The anode envelope 23 is attached to one end of an elongated member, shown here as a metal cylindrical member 27, to which the mirror 29 is mounted. The other end of the cylinder 27 may be flared for mounting the mirror 27 thereto by means of a glass frit 28 or glass solder. The wall thickness of the mid-section of the member 27 is somewhat thinner than the rest of the cylinder. This is so that the member 27 can be easily deflected along its axis for adjusting the mirror 29. The mirror 29 consists of a cylindrical glass substrate 30 having a quarter-wave filter 31, or other suitable filter deposited on one face. A quarter-wave filter 31 may be a series of coatings deposited on the glass substrate which selectively reflects the particular wavelength of the subject lasing gas. In order to seal the mirror 29 to the cylinder 27, the complete assembly, including a Brewster window (not shown) mounted within the cylinder 27, is placed into a 450°C oven where the glass frit melts and seals the mirror 29 to the flared end of the cylinder 27.

An outer member or collar shown here as a cylinder 33 is disposed about the inner cylindrical member 27 and attached thereto by a flanged end 34. The collar 33 may

BUREAU OMPI WIPO

be made of any suitable material which is sufficiently rigid so as not to be easily deflected. Materials such as aluminum, steel or even hard plastic may be used. The collar 33 may be attached to the inner cylindrical member 27 by welding, soldering, brazing or using an adhesive such as epoxy, for example.

The collar 33 has a plurality of adjustment screws 36a-36d, radially disposed about its circumference. Adjustment screws 36a and 36b are shown, while screws 36c and 36d are not shown but are perpendicular to the first two screws. In order to adjust the mirror 29 at the end of the inner cylinder 27, the screws are alternately tightened or loosened so as to deflect the inner cylinder 27 within its elastic limit. The outer member 33 serves several purposes; it adjusts the mirror and it also protects it from being accidentally disturbed if bumped. The collar 33 may also extend beyond the mirror 29 in order to provide greater protection. Another advantage of the present invention is that the elastic limit of the inner cylinder is not exceeded and thus the laser is easier to tune or adjust.

Although the invention has been shown and described with respect to particular embodiments, nevertheless, certain changes and modifications made by one skilled in the art to which the invention pertains are deemed within the purview of the invention.

BUREAU

Claims:

1. An adjustable mirror mount for a laser, comprising:

a cylindrical member attachable to a laser discharge tube for mounting a reflector to one end thereof; and

adjustment means disposed about the reflector end of said cylindrical member for deflecting said cylindrical member and thereby adjusting the position of said reflector.

2. The invention according to Claim 1 wherein said cylindrical member, comprises:

a cylinder having a selected thickness and a portion of the circumference having a reduced thickness for permitting said tubular member to be deflected along its axis.

3. The invention according to Claim 1 wherein said adjustment means comprise:

an outer member mounted to said cylindrical member and extending substantially the length of said cylindrical member; and

means extending from said outer member and impinging upon said cylindrical member for deflecting said cylindrical member along its axis.

4. The invention according to Claim 1 further comprising:

a reflector mounted to the end of said cylindrical member.

BUREAU OMPI WIPO INTERNATIONAL

5. An adjustable mirror mount for a laser, comprising:

a cylindrical member having first and second ends, said first end for mounting to a laser discharge tube, said second end for mounting a reflector thereto;

adjustment means radially disposed about and impinging upon said cylindrical member, said adjustment means for deflecting said reflector end of said cylindrical member thereby adjusting said reflector; and

means for supporting said adjustment means mounted to said first end of said cylindrical member.

6. An adjustable mirror mount for a laser, comprising:

a cylindrical member having first and second ends, said first end for mounting to a laser discharge tube, said second end for mounting a reflector;

an outer member having first and second ends being longitudinally mounted to said cylindrical member at said first ends; and

adjustment means mounted to the second end of said outer member for deflecting said cylindrical member and adjusting said reflector.

7. A laser having an adjustable mirror, comprising:

a laser discharge tube for containing a lasing medium;

a first elongated member, having first and second ends, mounted to said laser discharge tube by said first end;

a reflector mounted to said second end of said first elongated member;

BUREAU OMPI WIPO INTERNATIONAL

a second elongated member mounted coaxially, by one of its two ends, to said first elongated member; and

adjustment means rigidly mounted to the other end of said second elongated member for deflecting said first elongated member and adjusting said mirror thereby.

8. An adjustable mirror mount in accordance with Claim 6 wherein said adjustment means comprises:

a plurality of screws rotatably anchored in the second end of said second elongated member.

9. An adjustable mirror mount for a laser, comprising:

an elongated member directly attachable to and in fluid communication with a laser discharge tube for mounting a reflector to one end thereof;

an outer member having first and second ends, said first end being rigidly mounted to said elongated member, said outer member surrounding said elongated member; and

a plurality of radially disposed lever means extending through said outer member and impinging on said elongated member for deflecting said inner member thereby adjusting said reflector.

BUREAU OMPI WIPO INTERNATIO

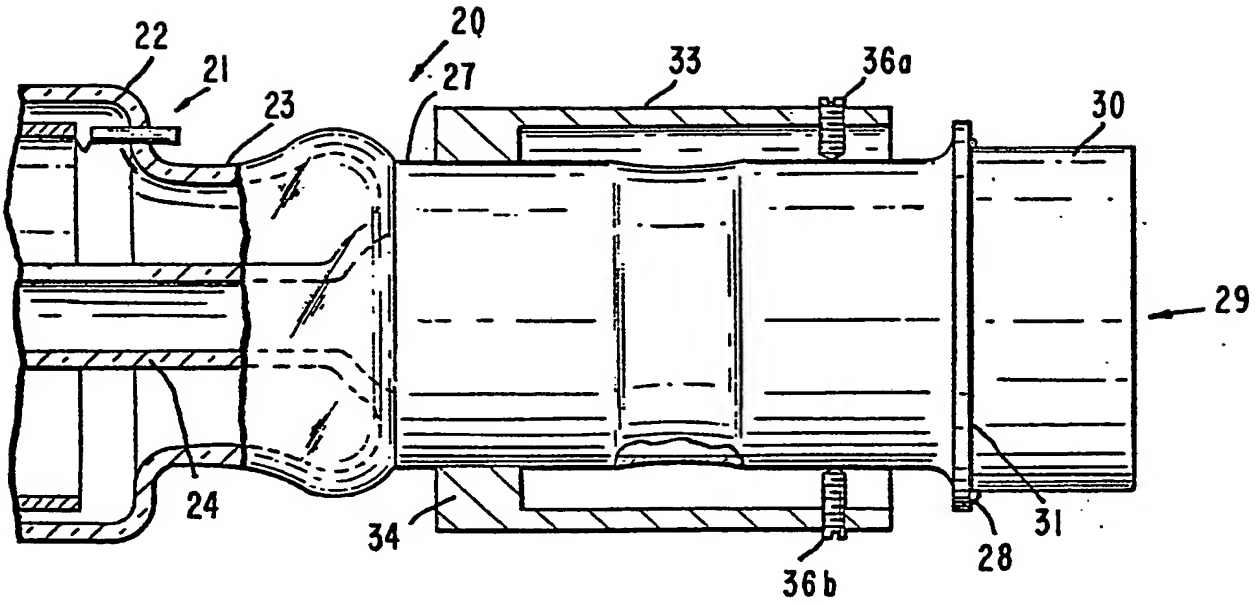


Fig. 1.

BUREAU OMPI WIPO

INTERNATIONAL SEARCH REPORT

International Application No PCT/US79/00881

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 3

According to International Patent Classification (IPC) or to both National Classification and IPC

INT CL. H01S 3/086
US CL. 331/94.5C

II. FIELDS SEARCHED

Minimum Documentation Searched 4

Classification System	Classification Symbols
US	331/94.5C, D; 350/288

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 5

III. DOCUMENTS CONSIDERED TO BE RELEVANT 14

Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
X	US A 3,826,998 Published 30 July 1974, Kindl et al	1, 2, 4
X	US A 3,864,029 Published 04 February 1975 Mohler	1, 4, 5
X	US A 3,883,820 Published 13 May 1975, Burns et al	1, 2, 4, 5
X	US A 3,953,113 Published 27 April 1976, Shull	1, 2, 4

* Special categories of cited documents: 15

"A" document defining the general state of the art
"E" earlier document but published on or after the international filing date
"L" document cited for special reason other than those referred to in the other categories
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but on or after the priority date claimed
"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention
"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search 2	Date of Mailing of this International Search Report 2
12 DECEMBER 1979	15 JAN 1980
International Searching Authority 1	**Signature of Authorized Officer 20**
ISA/US	W. Sikes William L. Sikes